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(71)(72) Applicant and Inventor: STEFENSON, Per [SE/SE]; Carl Grimbergsgatan 32, S-413 13 Göteborg (SE).

(74) Agents: GRAUDUMS, Valdis et al.; Albihn West AB, P.O. Box 142, S-401 22 Göteborg (SE).

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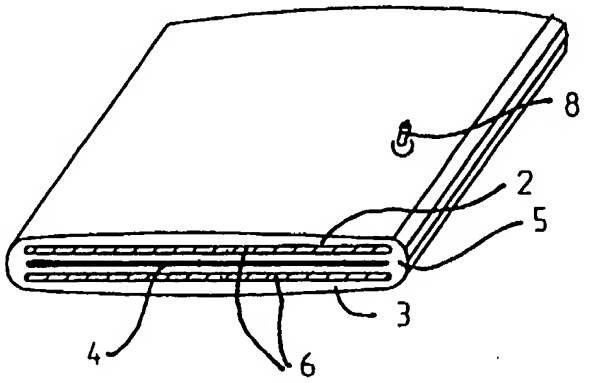
(54) Title: INFLATABLE CONSTRUCTION

(57) Abstract

Inflatable construction comprising a supporting element (1) with walls (2, 3) of a flexible fabric material defining an inner compartment (4). The inner compartment is arranged to be filled with gas under such pressure that the material is tensioned and thus imparts stiffness to the support element. When, however, the compartment is emptied of gas, the element is collapsible under folding of the material. In addition to the fabric material, the walls (2, 3) consist of sheets (6) of a semi-rigid bendable sheet material. These sheets allow folding-up or rolling-up of the support element when the compartment (4) is emptied of gas. In an inflated condition of the element (1), the sheets are bent together with the fabric material and form a channel-shape. Due to the chosen semi-rigid material, the element thus receives a considerable bending stiffness. A plurality of elements of this type can be assembled to create constructions such as evacuation slides, bridges etc.



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INFLATABLE CONSTRUCTION

TECHNICAL FIELD:

The present invention relates to an inflatable construction ranging from a construction element to assembled constructions for various purposes.

BACKGROUND OF THE INVENTION:

One example of an inflatable construction which can be built up is described in GB 2 105 264. This construction creates a slide for emergency evacuation, for example for transporting people in an emergency situation from the deck of a ship or the exit of an aeroplane to a water surface or the ground. This slide arrangement is made from a flexible fabric material which is air-tight and which forms channels. In a stand-by condition, the slide is stored in a rolled-up or folded-up condition in a compartment provided with a door. If the arrangement is mounted on a ship, the compartment is positioned on the side of the ship beneath an evacuation opening or a deck section. If the slide arrangement needs to be used in an emergency situation, the door of the compartment is opened and the slide made from fabric material begins to unfold. At the same time, a valve to a pressure vessel is opened so that the said channels are filled with air or another gas. In this manner, the slide is inflated to a stiff condition and forms a slideway from the evacuation location to a lower point. When used on a ship, the lower point is the water surface around the ship.

It may be necessary that such a slide arrangement bridges a long gap. When loaded, the arrangement will thus be

subjected to large bending forces. In order to withstand these, the channel system must be given a great stiffness by the provision of large cross-sectional dimensions and high pressure of the contained air. This in turn creates demands for a substantial fabric material which withstands this pressure. In addition to the high costs and bulkiness which such a construction implies, a high sensitivity to damage arises. Even if slightly punctured, the majority of the stiffness is lost.

Despite the great advantages which an inflatable construction provides for certain uses, above all the possibility to be stored folded-up in a small space when it is not needed to be employed, the use has been very much restricted because of said disadvantages of insufficient loading capacity when of reasonable dimensions as well as sensitivity to external damage.

SUMMARY OF THE INVENTION:

In accordance with the invention, the channel system consists not only of fabric material but also includes inner elements of a bendable sheet material. The system can be rolled-up or folded from a flat state. As long as the channel system is not inflated, the element can thus be rolled-up in a standby condition. When the slide is inflated, the sheet material adopts a curved condition and thus forms a stiff body due to its tube-like shape which thus requires substantial forces to be bent.

With such an arrangement, a construction which is very stiff in its use condition can be attained without the dimensions being particularly large and without any more complicated structural solutions needing to be adopted. In addition, the risk of piercing the wall of the pressurized chamber resulting in leakage is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS:

The invention will be described in the following with reference to four embodiments relating to both a simple construction element and a number of assembled constructions for various purposes. Reference will be made to the attached drawings in which there is shown in

Fig. 1 a portion of the arrangement in the form of a construction element and in a non-inflated condition;

Fig. 2 the same element portion in inflated condition;

Fig. 3 a section along line III-III in Fig. 5 of a bridge construction;

Fig. 4 an enlarged cross-section of a portion of the bridge construction;

Fig. 5 the bridge construction in elevation;

Fig. 6 the bridge construction in plan view;

Fig. 7 an elevational view of a slide for emergency evacuation;

Fig. 8 a cross-section of the slide along line VIII-VIII in Fig. 7;

Fig. 9 an end view of a barrier in inflated condition and

Fig. 10 a perspective view of the barrier from the side during erection by inflation.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS:

In Fig. 1 a portion of a tube 1 of a flexible fabric material is shown, preferably woven-reinforced rubber. The tube can be said to consist of two side portions 2 and 3 which, in the non-inflated condition of the tube shown in Fig. 1, lie against each other with their inwardly facing sides 4. In this manner, two longitudinally extending fold-edges 5 are formed. The fabric material in the sides 2 and 3 is doubled between the fold-edges 5 such that each side delimits a pocket.

A sheet 6 of a relatively stiff though bendable material is inserted in each of the two pockets. Preferably, the material is a semi-rigid plastic. The thickness of the sheets depends on the size of the tube, the larger the tube the greater the thickness should be, as well as the size of the intended bending load. Generally, the thickness can be considered to range from a few to a few tens of millimetres.

In the inflated condition of the tube which is shown in Fig. 2, the sides 2 and 3 are forced away from each other and their inner surfaces 4 form the inner wall of the now substantially cylindrical tube. Those regions 5 which previously formed fold-edges will now be accommodated in the cylindrical outer wall of the tube.

Since the fabric material is tensioned and adopts the described shape through inflation with an inner air-pressure, the sheets 6 are forced to follow this change in shape and form two opposed semi-cylindrical mantels in the cylindrical tube 2. With this shape, the sheets attained a substantial stiffness even if the material is only semi-rigid and make the tube substantially stiffer than a conventional construction consisting only of fabric material.

In a flattened condition, however, as shown in Fig. 1, the semi-rigid sheets can be bent if the tube is rolled-up or folded-up for storage.

As mentioned, the tube shown in Figs. 1 and 2 is only a short piece and the tube is intended to have a length of a number of meters. Its ends are thus sealed so that the enclosed air cannot flow out. One or more valves 8 are provided for inflation.

If a tube of such a length is to be collapsed, the rolling-up in its longitudinal extension is easily possible. If however it is desired to fold-up the tube, the sheets 6 can be split up so that folding locations are formed between sections of the sheets. This does of course result in a weakening of the bending resistance in the longitudinal direction, though the tube will in any event be substantially stiffer than a tube consisting solely of fabric material, since the ends of the sheets are substantially held together by the fabric material.

Figs. 3-6 show how a bridge construction can be constructed by tubes of the described type. If such a bridge construction has a relatively large span, the construction in the drawings can have a span of about 16 meters, the individual tubes would require a considerable cross-sectional dimension despite the stiffening effect of the sheets. In order to permit easier handling, according to the embodiment at least the primary supporting tubes are thus split up into a number of tubes with each being constructed in a manner as shown in Figs. 1 and 2. In this manner, the individual tubes can be made supporting, which can be of considerable importance since a bridge of this type is intended for emergency situations and also for military purposes where it may be necessary to rely solely on manpower for the erection.

As shown in the drawings, the bridge is in the form of two upper curved tube elements 10, the ends 11 of which are anchored in the ground and with the help of tensioning wires 12 tensioned in the shown curved-shape. It is these substantially supporting elements which preferably are an assembly of several tubes 13 which are kept together by a number of equally spaced apart rings 14. During inflation of the tubes 13, these are pressed against the ring 14 which may also consist of fabric material which is non-

extendable. In this manner, the tubes cannot be displaced with relation to each other, which increases the bending stiffness. With the help of support wires 15, the two supporting tubes support a bridge path 16 which has been shown in the form of panels placed one after the other. The panels are supported with the help of lower tubes 17 having the construction as shown in Figs. 1 and 2.

A slide for emergency evacuation is shown in Fig. 7. In Fig. 7, the slide is shown extending from the side 21 of a ship to a lifeboat 22. The slide is constructed of two side portions 23 each consisting of two tubes 24 arranged one over the other. A fabric sheet 25 is suspended between these sides and forms the floor portion which serves as the path or slide for the people who are to be evacuated.

The slide arrangement shown in the drawings is further provided with sides consisting of upper, double tubes 26 and angled cross-pieces 27 between the sides and the tubes 26 in order to build a framework.

For very long evacuation slides, such as those on large, high ships, such a framework can be necessary in order to impart sufficient stiffness without the tube dimensions as such being too large. In other words, a handier construction can be attained if the stiffness of the slide is imparted by a framework rather than by imparting stiffness through increased dimensions of individual tubes.

In the standby condition, the entire construction is rolled up and accommodated in a compartment 29 on the side of the ship. During use, the compartment is opened so that the rolled-up slide can fall out. At the same time, the construction is inflated with gas, in this case carbon dioxide, and thus attains the shape shown in Fig. 7. Thereafter, the life-raft 22 can be moved to its outer end.

Alternatively, the life-raft can be comprised in the construction and can be accommodated in the same compartment as the slide so that it reaches the position shown during the inflation.

A barrier is shown in Figs. 9 and 10. In its stand-by condition, it is folded-up and stored in a box 30. It consists of a number of tubes 31 which are affixed at 32 to the base of the box so that they can pivot between a collapsed position against the base of the box and an erect position. The tubes 31 are united with the top 33 of the construction. Each of the tubes 31 is constructed according to Figs. 1 and 2 and the inner sheets are folded at a hinge point 34 half way up the barrier. In addition to the inner sheets, the lower portion of the tubes can be supported by a frame construction 35 which can pivot about a bearing for each frame at the base 32 of the box. The described supporting construction is covered by a fabric envelope 38. In the standby state, the tubes 31 are emptied of air and can be folded at the point 34 and at the base of the box so that in this double-folded condition they can be laid in the box. The frames 35 are thereby swung downwardly as a layer between the upper and lower regions of the tubes.

When the barrier is to be erected, the tubes 31 are filled with air so that they straighten out and form upright straight post-like elements which erect the fabric envelope and tension it.

In Fig. 9, it is indicated that the box can be recessed and provided with flaps which swing upwardly due to the inner pressure when the construction begins to erect itself.

A barrier of this type can be used in different connections. One use is as a barrier against the spreading of fire or smoke or gases or liquids. The fabric envelope must

thus be adapted to the specific field of use and, for example, made of inflammable material if the barrier is to be used for restricting fire. Such a use is suitable where the risk arises for such spreading and where this can lead to serious damage.

The basic idea behind the invention, that an inflatable structure is stiffened by inserting sheets of a semi-rigid material in its pressure channels, can thus be adapted for many different purposes of which only a few of the most important have been mentioned here. Particularly advantageous is the application of such inflatable constructions which are exposed to large bending forces due to loads or wind forces. Thus, use in connection with marine travel is particularly important and in particular primarily as a slide for emergency evacuation, an embodiment which has also been described here.

It can be added that the construction element does not need to have the form of an individual tube as described in connection with Figs. 1 and 2. Alternatively, the elements can be integrally included in units with a plurality of gas chambers. Such a unit can for example be formed by two fabric sheets which are joined together along a number of seams so that a plurality of chambers are formed side by side. According to the invention, some or all of these chambers will include the said sheets.

CLAIMS

1. Inflatable construction comprising a supporting element (1) with walls (2, 3) of a flexible fabric material enclosing at least one inner compartment (4) which is arranged to be filled with gas under such pressure that the material is maintained tensioned and thus imparts stiffness to the support element, whilst when the compartment or compartments are emptied of gas the element is collapsible by bending of the material, c h a r a c t e r i z e d i n that in addition to the fabric material the walls (2, 3) also comprise sheets (6) of a semi-rigid bendable sheet material, which sheets are arranged to permit the support element to be folded-up or rolled-up when the compartment (4) or compartments are emptied of gas, though in an inflated condition of the element (10) the sheets bend together with the fabric material so that the sheets each adopt a channel-shape, preferably the shape of a semi-cylindrical mantle, and thus due to the chosen semi-rigid material the element is given considerable bending stiffness.

2. Inflatable construction according to claim 1, c h a r a c t e r i z e d i n that a plurality of elements of said embodiment (Figs. 1, 2) are arranged to run parallel to each other and are held together in a bundle (Fig. 4) by a plurality of rings (14), preferably ring-shaped, so that in this manner a supporting unit is formed.

3. Inflatable construction according to claim 1 or 2, c h a r a c t e r i z e d i n that the elements (1) of

said embodiment (Figs. 1, 2) are assembled to form a longitudinally extending evacuation slide comprising supporting side portions (23) extending in the longitudinal direction of the slide, said side portions (23) being spaced apart with a floor region (25) arranged therebetween to support people during use of the slide for evacuation, whereby said side portions comprise elements (24, 26) of said embodiment extending in the longitudinal direction of the slide.

4. Inflatable construction according to claim 3, c h a r a c t e r i z e d i n that said side portions (23) each consist of a plurality of elements (24, 26) spaced apart from each other and extending in the longitudinal direction of the slide and united with transverse elements (27) of said embodiment (Figs. 1, 2) arranged to form together with the elements extending in a longitudinal direction a side portion (23) in the form of a framework.

5. Inflatable construction according to claim 1 or 2, c h a r a c t e r i z e d i n that elements (16) of said embodiment (Figs. 1, 2) are assembled to form a bridge comprising a plurality of arched, upwardly curved supporting units (10) consisting of elements of said embodiment.

6. Inflatable construction according to claim 2, c h a r a c t e r i z e d i n that said supporting units (10) each comprise a bundle of elements of said embodiment (Fig. 1, 2).

7. Inflatable construction according to claim 5 or 6, c h a r a c t e r i z e d i n that said supporting units (10) are arranged to support a bridge path (16) by means of hanging wires (15).

8. Inflatable construction according to claim 1, c h a r a c t e r i z e d i n that the elements of said embodiment (Figs. 1, 2) are arranged in a non-inflatable condition to form a collapsible frame (31-35) which is covered by a fabric envelope (38) so that in an inflated condition of the elements a barrier is formed.

AMENDED CLAIMS
[received by the International Bureau on 04 May 1995 (04.05.95); original claims 1-8 replaced by amended claims 1-6 (3 pages)]

CLAIMS

1. Inflatable construction comprising a supporting structure including elements (1) with walls (2, 3) of a flexible fabric material enclosing at least one inner compartment (4) which is arranged to be filled with gas under such pressure that the material is maintained tensioned and thus imparts stiffness to the element, whilst when the compartment or compartments are emptied of gas the element is collapsible by bending of the material, the construction being in the form of a longitudinally extending evacuation slide (Fig. 7) comprising supporting side portions (23) extending in the longitudinal direction of the slide, said side portions (23) being spaced apart with a floor region (25) arranged therebetween to support people during use of the slide for evacuation, whereby said side portions comprise main supporting elements (24, 26) extending in the longitudinal direction of the slide, c h a r a c t e r i z e d in that said main supporting elements (24, 26) in addition to the fabric material of the walls (2, 3) also comprise sheets (6) of a semi-rigid bendable sheet material, which in the inflated condition of the main supporting elements (24, 26) bend together with the fabric material so that the sheets each adopt a channel-shape, preferably the shape of a semi-cylindrical mantle, and thus due to the chosen semi-rigid material the supporting element is given considerable bending stiffness, but also being provided to be folded-up or rolled-up when the compartment (4) or compartments are emptied of gas.

2. Inflatable construction according to claim 1, c h a r a c t e r i z e d in that said side portions (23) each consist of a plurality of elements (24, 26) spaced apart from each other and extending in the longitudinal direction of the slide and united with transverse elements (27) connecting in oblique angle to the elements extending in longitudinal direction and so that all said elements together form a side portion (23) in the shape of a framework.

3. Inflatable construction comprising a supporting structure including elements (1) with walls (2, 3) of a flexible fabric material enclosing at least one inner compartment (4) which is arranged to be filled with gas under such pressure that the material is maintained tensioned and thus imparts stiffness to the element, whilst when the compartment or compartments are emptied of gas the element is collapsible by bending of the material, c h a r a c t e r i z e d in that the construction being in the form of a suspension bridge (Figs. 3-6) comprising a number, preferably two, main supporting elements (10) which in addition to the fabric material of the walls (2, 3) also comprise sheets (6) of a semi-rigid bendable sheet material, which in the inflated condition of the main supporting elements bend together with the fabric material so that the sheets each adopt a channel-shape, preferably the shape of a semi-cylindrical mantle, and thus due to the chosen semi-rigid material the element is given considerable bending stiffness, but also being provided to be folded-up or rolled-up when the compartment (4) or compartments are emptied of gas, said main supporting elements (10) are arched upwardly forming suspending beams carrying by means of support wires (15) a bridge path (16).

4. Inflatable construction according to claim 3, c h a r a c t e r i z e d in that said main supporting elements (10) each comprise a bundle of elements (13) of the composition specified.

5. Inflatable construction according to claim 4, c h a r a c t e r i z e d in that the elements (13) of said bundle are held together by a plurality of rings (14) spaced from each other.

6. Inflatable construction comprising a supporting structure including elements (1) with walls (2, 3) of a flexible fabric material enclosing at least one inner compartment (4) which is arranged to be filled with gas under such pressure that the material is maintained tensioned and thus imparts stiffness to the element, whilst when the compartment or compartments are emptied of gas the elements is collapsible by bending of the material, c h a r a c t e r i z e d in that the construction being in the form of barrier (Figs. 9, 10) comprising a number of main supporting elements (31), which in addition to the fabric material of the walls (2, 3) also comprise sheets (6) of a semi-rigid bendable sheet material, which in the inflated condition of the main supporting elements bend together with the fabric material so that the sheets each adopt a channel-shape, preferably the shape of a semi-cylindrical mantle, and thus due to the chosen semi-rigid material the element is given considerable bending stiffness, but also being provided to be folded-up or rolled-up when the compartment (4) or compartments are emptied of gas, said main supporting elements (31) arranged in inflatable condition to form a frame (31-35) which is covered by a fabric envelope (38) so that in the inflated condition of the elements the barrier is formed, while in non-inflatable condition of the elements (31) the same are folded up to form a low, compressed structure.

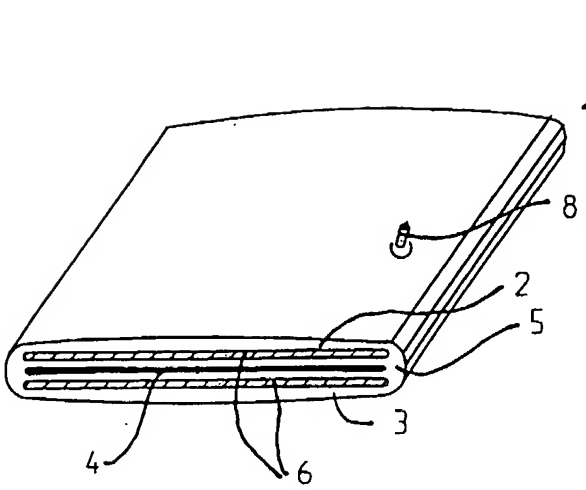

Fig. 1

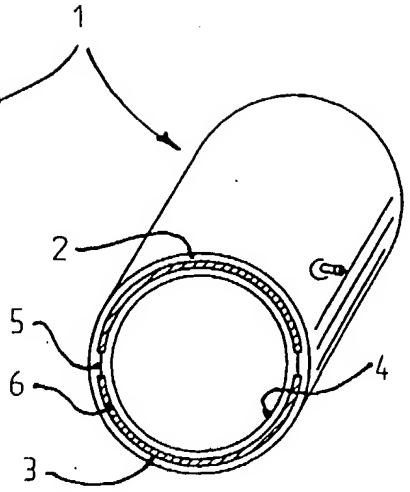

Fig. 2

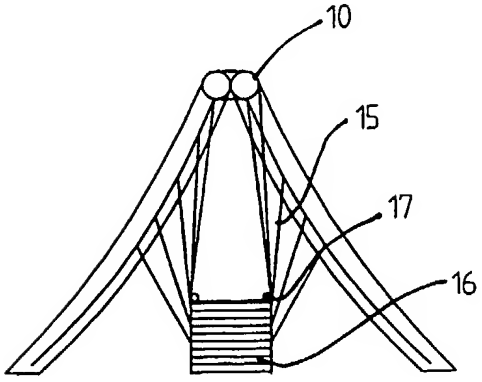

Fig. 3

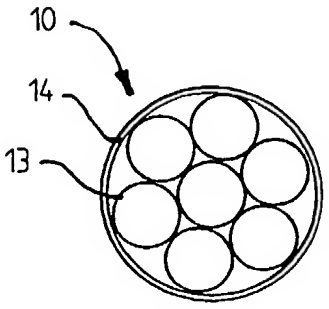

Fig. 4

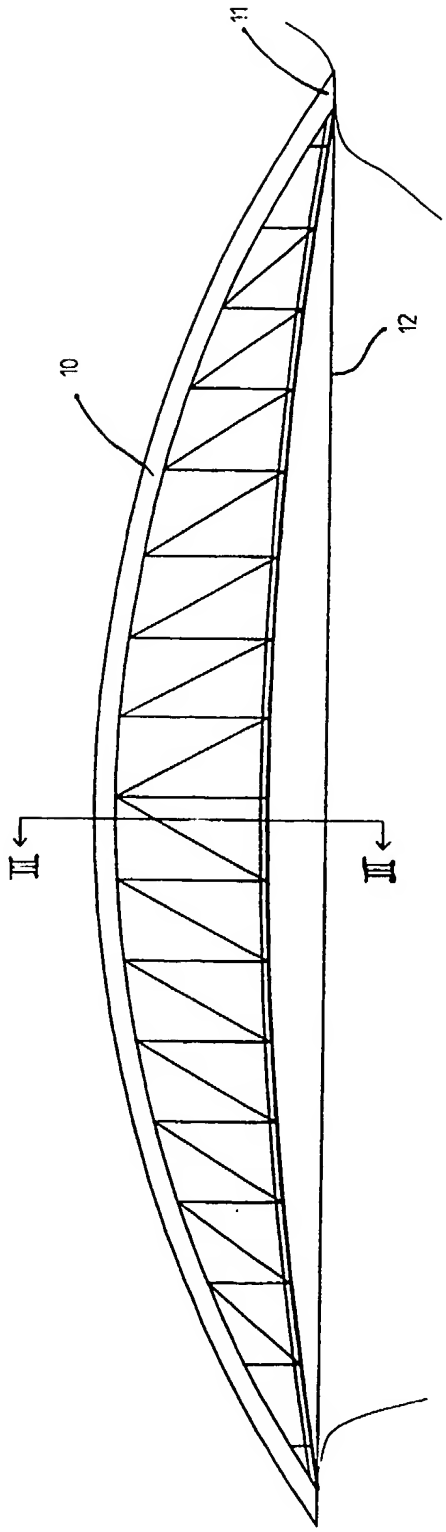

Fig. 5

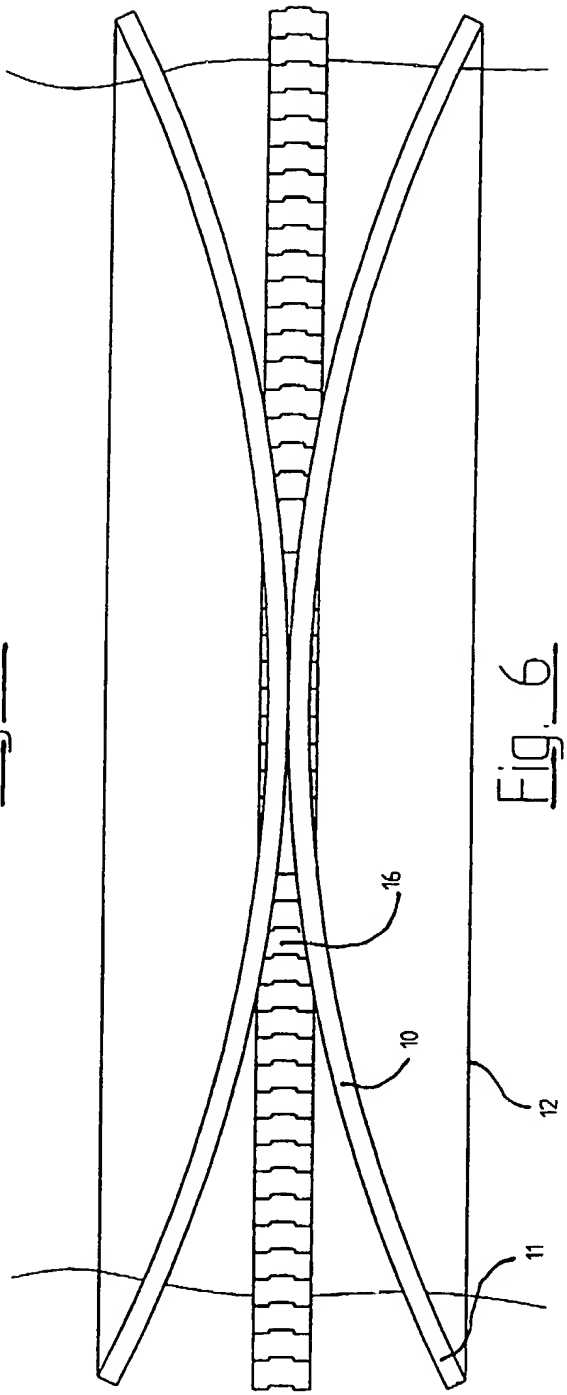

Fig. 6

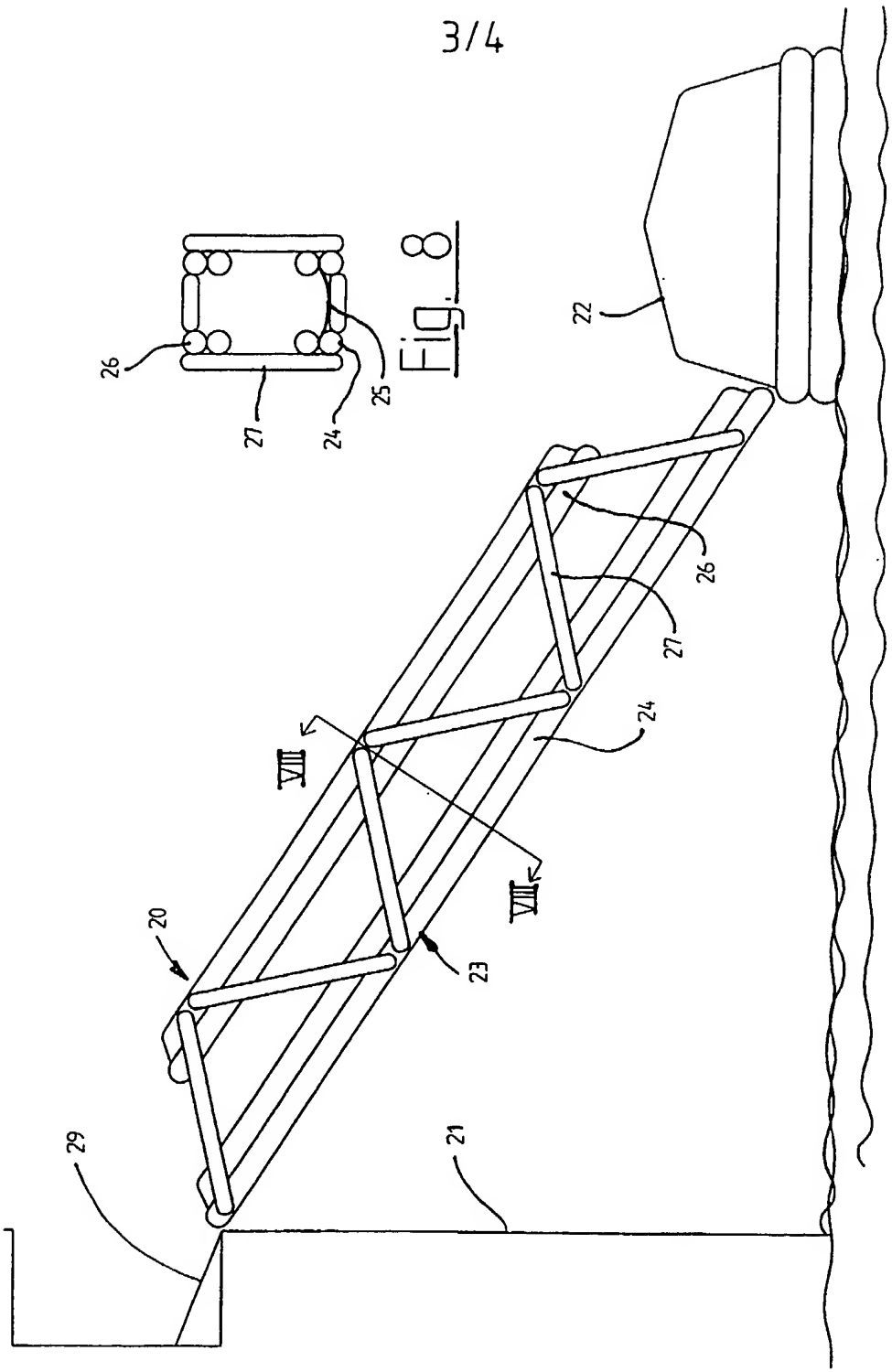

Fig. 7

Fig. 8

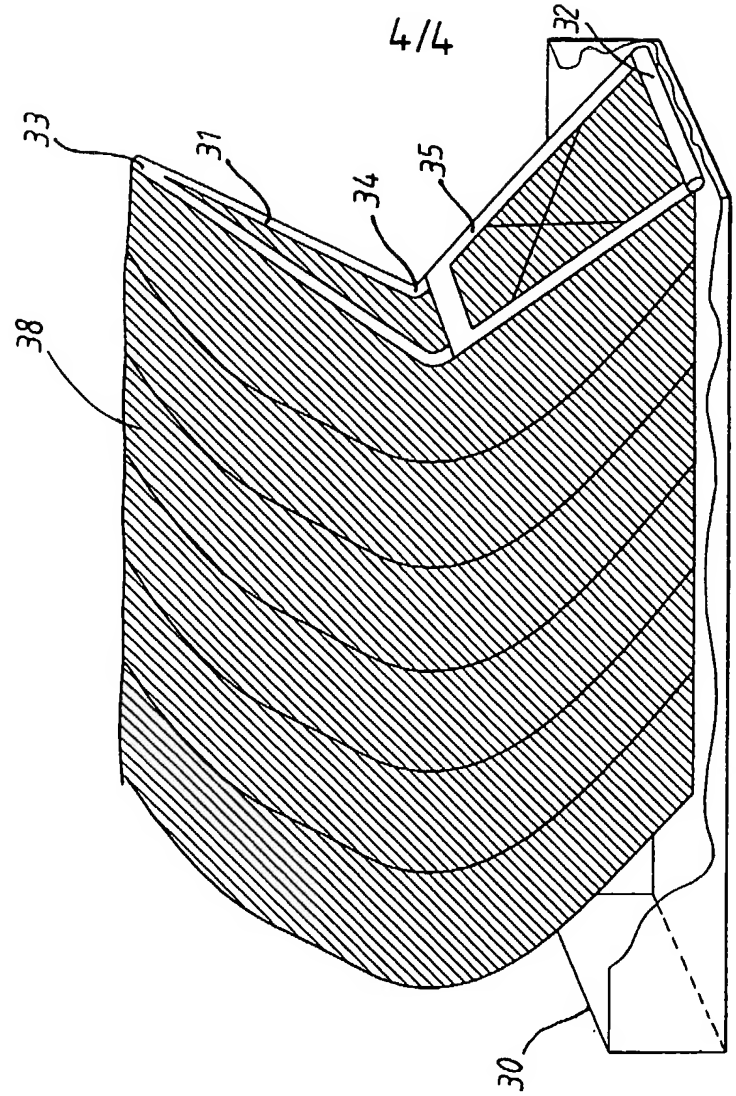

Fig. 10

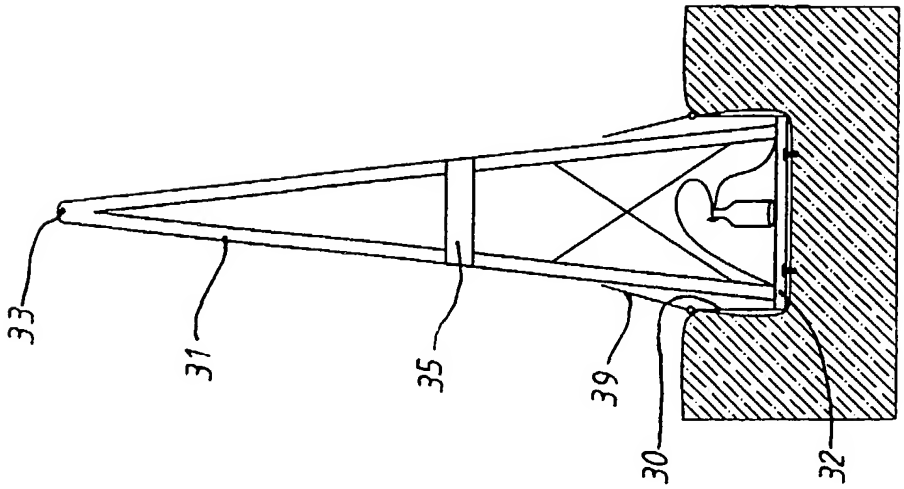

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 94/01171

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A62B 1/20, B64D 25/14, B63B 7/08, E01D 15/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A62B, B64D, B63B, E01D, B63C, E01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPOQUE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 3364632 (P. ISAAC), 23 January 1968 (23.01.68), column 2, line 67 - column 4, line 22, figures 1-2	1
Y		2-4
A		5-8
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Y	SE, B, 468992 (TRELLEBORG INDUSTRI AB), 26 April 1993 (26.04.93), figures 1-2	2-4
A		5-7
	--	
A	EP, A1, 0383033 (INDUSTRIE PIRELLI S.P.A.), 22 August 1990 (22.08.90), the figures	3-4
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 March 1995	17 -03- 1995
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Mariana Eddin Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 94/01171

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4106149 (E.J. LARSSON), 15 August 1978 (15.08.78), the figures	5-6

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INTERNATIONAL SEARCH REPORT

Information on patent family members

09/02/95

International application No.
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